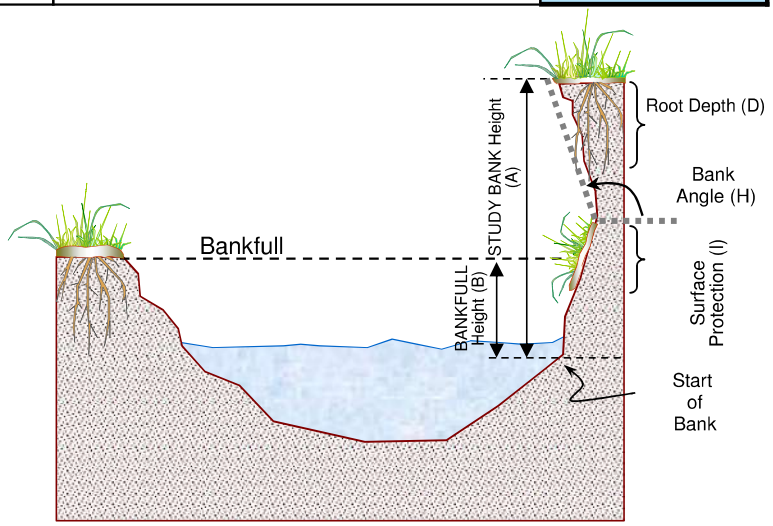
Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream:	**Holmes Run**	Location:	**BEHI #1**
Station:	**85 ft**	Observers:	**Biggs/Hepp**
Date:	**3/27/18**	Stream Type: **F3/F4**	Valley Type: **VI**

				Study Bank Height / Bankfull Height (C)		**BEHI Score (Fig. 3-7)**
Study Bank Height (ft) =	**7.00 (A)**	**Bankfull Height** (ft) =	**2.50 (B)**	(A) / (B) =	**2.80 (C)**	**9.0**
				Root Depth / Study Bank Height (E)		
Root Depth (ft) =	**3.00 (D)**	**Study Bank Height** (ft) =	**7.00 (A)**	(D) / (A) =	**0.43 (E)**	**4.5**
				Weighted Root Density (G)		
		Root Density as % =	**35.00 (F)**	(F) × (E) =	**15.00 (G)**	**8.0**
				Bank Angle (H)		
				Bank Angle as *Degrees* =	**80 (H)**	**5.9**
				Surface Protection (I)		
				Surface Protection as % =	**20% (I)**	**7.0**

Bank Material Adjustment:		
Bedrock (Overall Very Low BEHI) **Boulders** (Overall Low BEHI) **Cobble** (Subtract 10 points if uniform medium to large cobble) **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand) **Sand** (Add 10 points) **Silt/Clay** (no adjustment)	**Bank Material Adjustment**	**5**
	Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	**5**

Very Low	Low	Moderate	High	Very High	Extreme		
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	**Adjective Rating** and **Total Score**	**Very High** **44.4**



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Holmes Run** Location: **BEHI #1**

Station: **85 ft** Stream Type: **F3/F4** Valley Type: **VI**

Observers: **Biggs/Hepp** Date: **3/27/18**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I — (1)

Transverse and/or central bars-short and/or discontinuous…….. ……..…NBS = High / Very High

Extensive deposition (continuous, cross-channel)…….…….…….. ……...NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…….……..NBS = Extreme

Level II

(2) Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3) Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4) Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress
High

Level III

(5) Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6) Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7) Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **High**

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream:	**Holmes Run**	Location:	**BEHI #2**
Station:	**148 ft**	Observers:	**Biggs/Hepp**
Date:	**3/27/18**	Stream Type: **F3/F4**	Valley Type: **VI**

						BEHI Score (Fig. 3-7)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	5.00 (A)	Bankfull Height (ft) =	2.50 (B)	(A) / (B) =	2.00 (C)	7.9
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	2.50 (D)	Study Bank Height (ft) =	5.00 (A)	(D) / (A) =	0.50 (E)	3.9
Weighted Root Density (G)						
Root Density as % =	20.00 (F)			(F) × (E) =	10.00 (G)	8.5
Bank Angle (H)						
Bank Angle as *Degrees* =	75 (H)					5.3
Surface Protection (I)						
Surface Protection as % =	20% (I)					7.0

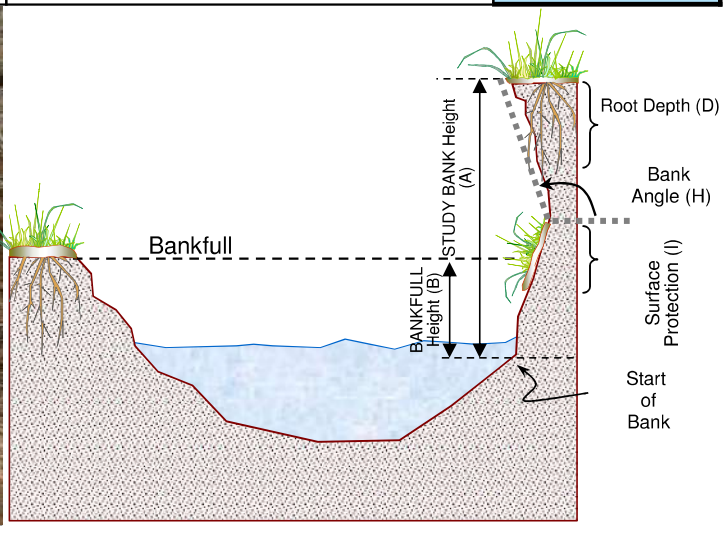
Bank Material Adjustment:

Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment: 0

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 0

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	High / 32.6
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Holmes Run** Location: **BEHI #2**

Station: **148 ft** Stream Type: **F3/F4** Valley Type: **VI**

Observers: **Biggs/Hepp** Date: **3/27/18**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)

Transverse and/or central bars-short and/or discontinuous……..NBS = High / Very High

Extensive deposition (continuous, cross-channel)……..NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow……..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

High

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **High**

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream:	**Holmes Run**	Location:	**BEHI #3**
Station:	**220 ft**	Observers:	**Biggs/Hepp**
Date:	**3/27/18**	Stream Type: **F3/F4**	Valley Type: **VI**

							BEHI Score (Fig. 3-7)
Study Bank Height / Bankfull Height (C)							
Study Bank Height (ft) =	**8.00** (A)	**Bankfull Height** (ft) =	**2.50** (B)	(A) / (B) =	**3.20** (C)		**9.7**
Root Depth / Study Bank Height (E)							
Root Depth (ft) =	**3.00** (D)	**Study Bank Height** (ft) =	**8.00** (A)	(D) / (A) =	**0.38** (E)		**4.9**
Weighted Root Density (G)							
Root Density as % =		**15.00** (F)		(F) × (E) =	**5.63** (G)		**9.0**
Bank Angle (H)							
Bank Angle as *Degrees* =					**90** (H)		**8.0**
Surface Protection (I)							
Surface Protection as % =					**15%** (I)		**8.0**

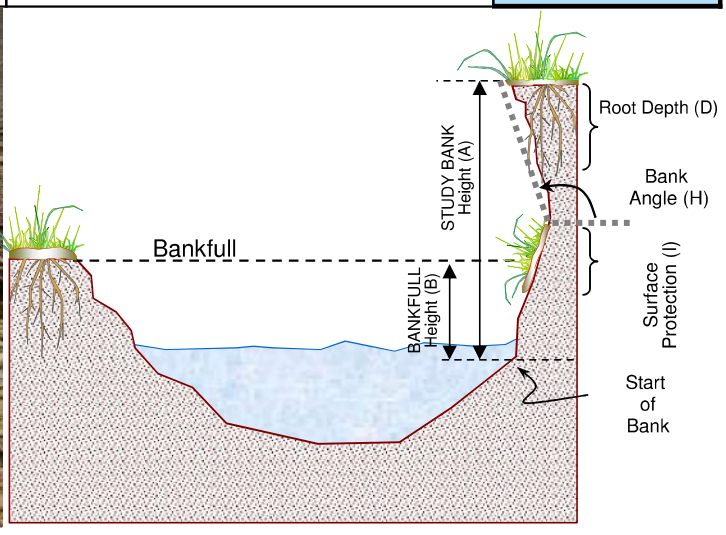
Bank Material Adjustment:

- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no adjustment)

Bank Material Adjustment: **5**

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: **5**

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		49.6



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Holmes Run** Location: **BEHI #3**

Station: **220 ft** Stream Type: **F3/F4** Valley Type: **VI**

Observers: **Biggs/Hepp** Date: **3/27/18**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)

Transverse and/or central bars-short and/or discontinuous…… ……..…NBS = High / Very High

Extensive deposition (continuous, cross-channel)……..…….…..…… ……...NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…….……..…NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

High

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **High**

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream:	**Holmes Run**	Location:	**BEHI #4**
Station:	**263 ft**	Observers:	**Biggs/Hepp**
Date:	**3/27/18**	Stream Type: **F3/F4**	Valley Type: **VI**

							BEHI Score (Fig. 3-7)
Study Bank Height / Bankfull Height (C)							
Study Bank Height (ft) =	**6.50**	**(A)**	**Bankfull Height** (ft) =	**2.50**	**(B)**	(A) / (B) = **2.60** **(C)**	**8.8**
Root Depth / Study Bank Height (E)							
Root Depth (ft) =	**1.00**	**(D)**	**Study Bank Height** (ft) =	**6.50**	**(A)**	(D) / (A) = **0.15** **(E)**	**8.0**
Weighted Root Density (G)							
Root Density as % =	**10.00**	**(F)**				(F) × (E) = **1.54** **(G)**	**9.5**
Bank Angle (H)							
Bank Angle as *Degrees* =	**90**	**(H)**					**8.0**
Surface Protection (I)							
Surface Protection as % =	**5%**	**(I)**					**10.0**

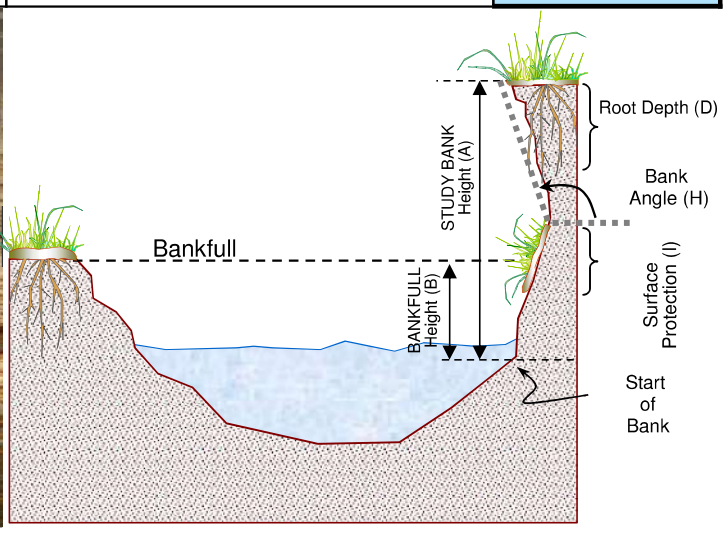
Bank Material Adjustment:

Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment = **5**

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage = **5**

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		54.3



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Holmes Run** Location: **BEHI #4**

Station: **263 ft** Stream Type: **F3/F4** Valley Type: **VI**

Observers: **Biggs/Hepp** Date: **3/27/18**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I **(1)**

Transverse and/or central bars-short and/or discontinuous……..NBS = High / Very High

Extensive deposition (continuous, cross-channel)……..NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow……NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

Very High

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Very High**

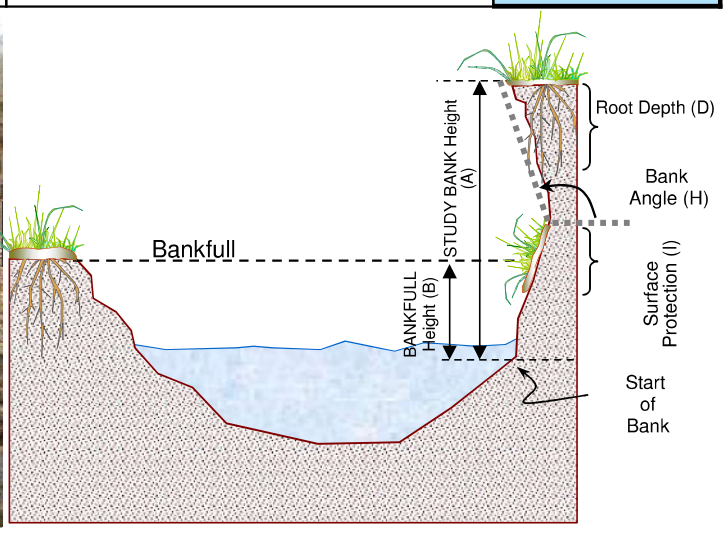
Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream:	**Holmes Run**	Location:	**BEHI #8**
Station:	**290 ft**	Observers:	**Biggs/Hepp**
Date:	**3/27/18**	Stream Type: **F3/F4**	Valley Type: **VI**

				Study Bank Height / Bankfull Height (C)		**BEHI Score (Fig. 3-7)**
Study Bank Height (ft) =	**10.00 (A)**	**Bankfull Height** (ft) =	**2.50 (B)**	(A) / (B) =	**4.00 (C)**	**10.0**
				Root Depth / Study Bank Height (E)		
Root Depth (ft) =	**7.00 (D)**	**Study Bank Height** (ft) =	**10.00 (A)**	(D) / (A) =	**0.70 (E)**	**3.0**
				Weighted Root Density (G)		
		Root Density as % =	**30.00 (F)**	(F) × (E) =	**21.00 (G)**	**6.9**
				Bank Angle (H)		
				Bank Angle as *Degrees* =	**90 (H)**	**8.0**
				Surface Protection (I)		
				Surface Protection as % =	**15% (I)**	**8.0**

Bank Material Adjustment:		
Bedrock (Overall Very Low BEHI) **Boulders** (Overall Low BEHI) **Cobble** (Subtract 10 points if uniform medium to large cobble) **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand) **Sand** (Add 10 points) **Silt/Clay** (no adjustment)	**Bank Material Adjustment**	**5**
	Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	**5**

Very Low	Low	Moderate	High	Very High	Extreme		
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	**Adjective Rating** and **Total Score**	**Very High** **45.9**



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Holmes Run** Location: **BEHI #8**

Station: **290 ft** Stream Type: **F3/F4** Valley Type: **VI**

Observers: **Biggs/Hepp** Date: **3/27/18**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)

Transverse and/or central bars-short and/or discontinuous…….. ……..…NBS = High / Very High

Extensive deposition (continuous, cross-channel)……..…….…..…… ……...NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…….……..…NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

Moderate

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

Worksheet 3-13. Summary form of annual streambank erosion estimates for various study reaches.

Stream:	**Holmes Run**			Location: **Project Reach**			
Graph Used:	**District of Columbia**	Total Stream Length (ft): **1307.0**				Date: **7/16/18**	
Observers:	**Biggs/Hepp**		Valley Type: **VI**			Stream Type: **F3/F4**	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Station (ft)	**BEHI rating (Worksheet 3-11) (adjective)**	**NBS rating (Worksheet 3-12) (adjective)**	**Bank erosion rate (Figure 3-9 or 3-10) (ft/yr)**	**Length of bank (ft)**	**Study bank height (ft)**	**Erosion subtotal [(4)×(5)×(6)] (ft^3/yr)**	**Erosion Rate (tons/yr/ft)**
1. **BEHI #1**	**Very High**	**High**	**1.00**	**85.0**	**7.0**	**595.00**	**0.420**
2. **BEHI #2**	**High**	**High**	**1.00**	**148.0**	**5.0**	**740.00**	**0.300**
3. **BEHI #3**	**Extreme**	**High**	**2.40**	**220.0**	**8.0**	**4224.00**	**1.152**
4. **BEHI #4**	**Extreme**	**Very High**	**3.20**	**263.0**	**6.5**	**5470.40**	**1.248**
5. **BEHI #5***	**High**	**High**	**1.00**	**78.0**	**6.0**	**468.00**	**0.360**
6. **BEHI #6***	**Moderate**	**Low**	**0.12**	**101.0**	**3.0**	**36.36**	**0.022**
7. **BEHI #7***	**Low**	**Low**	**0.02**	**42.0**	**3.5**	**2.50**	**0.004**
8. **BEHI #8**	**Very High**	**Moderate**	**0.50**	**290.0**	**10.0**	**1450.00**	**0.300**
9. **BEHI #9***	**Moderate**	**Low**	**0.12**	**80.0**	**9.0**	**86.40**	**0.065**
Sum erosion subtotals in Column (7) for each BEHI/NBS combination					**Total Erosion (ft^3/yr)**	**13072.66**	
Convert erosion in ft^3/yr to yds^3/yr {divide Total Erosion (ft^3/yr) by 27}					**Total Erosion (yds^3/yr)**	**484.17**	
Dry Bulk Density of the Soil is 120 lb/cf.					**Total Erosion (tons/yr)**	**784.36**	
Calculate erosion per unit length of channel {divide Total Erosion (tons/yr) by total length of stream (ft) surveyed}					**Total Erosion (tons/yr/ft)**	**0.600**	

* **BEHI and NBS ratings were determined using ocular estimates and field calibration technique as described in Section 3.2**